Notice No.1

for the

Code for Lifting Appliances in a Marine Environment, July 2022

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.
Please note for the corrigenda items paragraphs, Tables and Figures are not shown in their entirety.

Issue date: December 2022

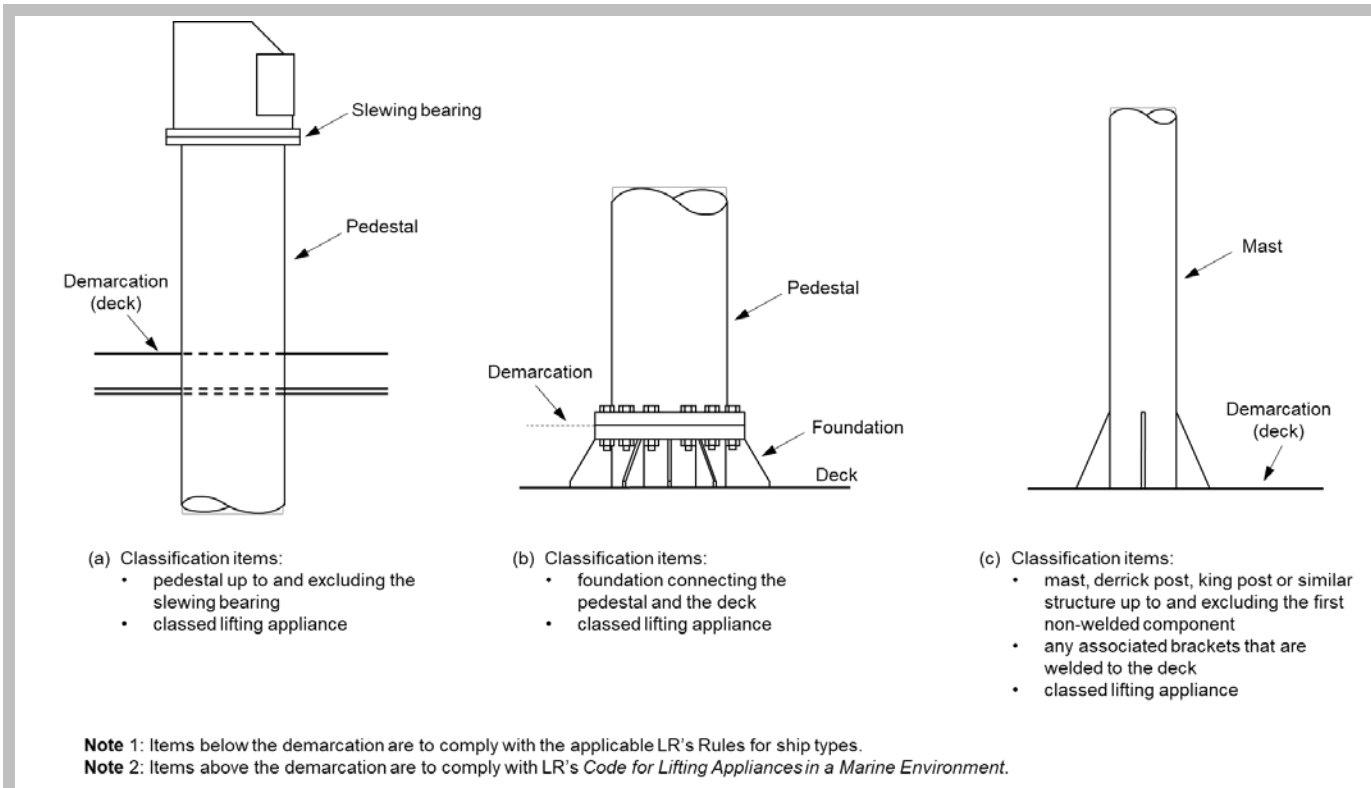
Amendments to	Effective date	IACS/IMO implementation (if applicable)
Chapter 1, Sections 1 & 5	1 January 2023	N/A
Chapter 2, Section 1	1 January 2023	N/A
Chapter 3, Section 1	1 January 2023	N/A
Chapter 4, Sections 2, 3, 4, 5, 7 & 8	1 January 2023	N/A
Chapter 5, Section 3	1 January 2023	N/A
Chapter 6, Section 2	1 January 2023	N/A
Chapter 7, Section 2	1 January 2023	N/A
Chapter 8, Sections 1, 3, & 4	1 January 2023	N/A
Chapter 9, Sections 2 & 4	1 January 2023	N/A
Chapter 11, Sections 1, 2, 3 & 4	1 January 2023	N/A
Chapter 12, Sections 1 & 3	1 January 2023	N/A

Chapter 1
General

■ *Section 1*
Introduction

1.1 Application

1.1.13 It is also emphasised that any ~~item such as a mast or crane pedestal~~ lifting appliance support structure (such as a mast or a crane pedestal), which is ~~permanently fitted~~ welded to a ship's structure ~~and which is designed to support a lifting appliance~~, ~~does~~ constitutes part of the classed ship or classed offshore unit and is to comply with the appropriate classification requirements, even where the lifting appliance itself is not classed or certified by LR, *see Figure 1.1.1 Classification items and applicability of LR's requirements for lifting appliance pedestals and foundations*.



(a) Classification items:
- pedestal up to and excluding the slewing bearing
- classed lifting appliance

(b) Classification items:
- foundation connecting the pedestal and the deck
- classed lifting appliance

(c) Classification items:
- mast, derrick post, king post or similar structure up to and excluding the first non-welded component
- any associated brackets that are welded to the deck
- classed lifting appliance

Note 1: Items below the demarcation are to comply with the applicable LR's Rules for ship types.
Note 2: Items above the demarcation are to comply with LR's *Code for Lifting Appliances in a Marine Environment*.

Figure 1.1.1 Classification items and applicability of LR's requirements for lifting appliance pedestals and foundations

1.6 Materials and fabrication

Existing paragraphs 1.6.1 and 1.6.2 have been deleted and replaced with the below:

1.6.1 Materials intended for the construction, or repair, of classed lifting appliances are to be in accordance with LR's *Rules for the Manufacture, Testing and Certification of Materials*. All material shall be sourced from an LR approved manufacturer, *see Ch 1, 2.1 Approval and survey requirements – General* of the *Rules for the Manufacture, Testing and Certification of Materials*. The materials shall be ordered to be supplied with an 'LR certificate' or 'Manufacturer's certificate validated by LR', as defined in *Ch 1, 3 Certification of materials* of the *Rules for the Manufacture, Testing and Certification of Materials*.

1.6.2 The material specification shall be according to the materials specified in the *Rules for the Manufacture, Testing and Certification of Materials*.

1.6.3 Alternatives to the above material specification requirements given in *Ch 1, 1.6 Materials and fabrication 1.6.2* are outlined in *Ch 1, 1.6 Materials and fabrication 1.6.4* and *Ch 1, 1.6 Materials and fabrication 1.6.5*; however, the approval and survey requirements are to be in compliance with *Ch 1 General Requirements*, and Section 1 of subsequent Chapters, of the *Rules for the Manufacture, Testing and Certification of Materials* as appropriate.

1.6.4 If the material specification is to be defined in accordance with a recognised National or International Standard that is equivalent to those specified in the *Rules for the Manufacture, Testing and Certification of Materials*, then the following aspects are

to be considered as a minimum in order to achieve equivalency with the *Rules for the Manufacture, Testing and Certification of Materials*:

(a) The proposed material needs to be sourced from an LR approved manufacturer.
(b) The materials shall be ordered to be supplied with an 'LR certificate' or 'Manufacturer's certificate validated by LR', as defined in *Ch 1, 3 Certification of materials* of the *Rules for the Manufacture, Testing and Certification of Materials*.
(c) The proposed material needs to be equivalent to at least one product within the manufacturer's scope of LR approval. The equivalency needs to be confirmed by LR on a case-by-case basis.
(d) The mechanical properties of the proposed material are to be similar to the equivalent type or grade in the *Rules for the Manufacture, Testing and Certification of Materials*. The specified mechanical properties (e.g. yield strength depending on material thickness) of the proposed material are to meet the design requirements of the lifting appliance.
(e) The chemical composition, heat treatment condition and any other specific condition, grade or property (e.g. through thickness property) of the proposed material are to be similar to the equivalent material type or grade in the *Rules for the Manufacture, Testing and Certification of Materials*.
(f) The Charpy V-notch impact test requirements of the proposed material are to be in accordance with the relevant design requirements of this Code.
(g) The surface quality, internal soundness and dimensional tolerances are to be equivalent to the applicable requirements in *Rules for the Manufacture, Testing and Certification of Materials*.
(h) The Non-Destructive Examination of the proposed material is to be equivalent to *Ch 1, 5 Non-destructive examination* of the *Rules for the Manufacture, Testing and Certification of Materials*.

1.6.5 If the material specification is to be approved by LR for a specific application then the following aspects are to be considered as a minimum:

(a) The proposed material needs to be sourced from an LR approved manufacturer.
(b) The materials shall be ordered to be supplied with an 'LR certificate' or 'Manufacturer's certificate validated by LR', as defined in *Ch 1, 3 Certification of materials* of the *Rules for the Manufacture, Testing and Certification of Materials*.
(c) The LR approved manufacturer shall have demonstrated capability to produce the proposed material with equivalency in thickness range, grain refinement, chemistry, rolling, heat treatment and supply condition. This equivalency needs to be confirmed by LR on a case-by-case basis.
(d) The specified mechanical properties (e.g. yield strength depending on material thickness) of the proposed material are to meet the design requirements of the lifting appliance.
(e) The Charpy V-notch impact test requirements of the proposed material are to be in accordance with the relevant design requirements of this Code.
(f) Surface quality, internal soundness and dimensional tolerances shall be suitable for the intended application.
(g) The aspects of Non-Destructive Examination of the proposed material are to be suitable for the intended application.

1.6.6 Materials intended for the construction of certified lifting appliances are, as a minimum, to be in accordance with a recognised National or International Standard that includes materials which are equivalent to those specified in the *Rules for the Manufacture, Testing and Certification of Materials*. In this case, the approval and survey requirements may not comply with the requirements of *Ch 1 General Requirements*, and Section 1 of subsequent Chapters, of the *Rules for the Manufacture, Testing and Certification of Materials* and therefore the proposed materials may, at the discretion of the Surveyor, be subject to additional testing under LR survey prior to acceptance for any project.

1.6.7 Materials that are not addressed by *Ch 1, 1.6 Materials and fabrication 1.6.1, Ch 1, 1.6 Materials and fabrication 1.6.2, Ch 1, 1.6 Materials and fabrication 1.6.3, Ch 1, 1.6 Materials and fabrication 1.6.4, Ch 1, 1.6 Materials and fabrication 1.6.5* or *Ch 1, 1.6 Materials and fabrication 1.6.6* will be subject to special consideration by LR for both classed and certified applications.

1.6.8 An overview of the routes to achieve material acceptance for lifting appliances which are to be classed or certified by LR is provided in *Table 1.1.2 Material requirements for classed and certified lifting appliances*.

Table 1.1.2 Material requirements for classed and certified lifting appliances

Material requirements	Applicability
see Ch 1, 1.6 Materials and fabrication 1.6.1, Ch 1, 1.6 Materials and fabrication 1.6.2, Ch 1, 1.6 Materials and fabrication 1.6.3, Ch 1, 1.6 Materials and fabrication 1.6.4 and *Ch 1, 1.6 Materials and fabrication 1.6.5*	Classed and certified lifting appliances
see Ch 1, 1.6 Materials and fabrication 1.6.6	Certified lifting appliances
see Ch 1, 1.6 Materials and fabrication 1.6.7	Classed and certified lifting appliances, subject to special consideration by LR in each case

1.6.9 Fabrication and Non-Destructive Examination of lifting appliances is to be in accordance with the *Rules for the Manufacture, Testing and Certification of Materials* and specific requirements of this Code, *see Ch 11 Materials and Fabrication*. Where alternative fabrication standards are proposed, these are to provide equivalence to these requirements.

■ *Section 5*
Quality assurance system

5.1 General

5.1.1 The lifting or life-saving appliance designer/manufacturer shall have a documented Quality Assurance System with a 'continuous improvement process' in place. The quality assurance system shall be in compliance with a recognised National or International Standard, e.g. ISO 9001 *Quality management systems – Requirements*.

5.2 Continuous improvement

5.2.1 The continuous improvement process as part of the quality assurance system shall take account of the findings from operational and non-operational experience and feedback with a view to:

(a) further improvements in the design, operating procedures and instructions for use;

(b) further improvements to the maintenance of existing appliances in service;

(c) an adjustment of inspection intervals; and

(d) an adjustment of scheduled maintenance and replacements of parts.

5.2.2 The operational and non-operational experience and feedback may be provided through the designer's/manufacturer's own experiences and/or provided by the lifting or life-saving appliance's Owner and/or Operator, maintainers, inspectors/Surveyors and competent persons or organisations.

Chapter 2
Derrick Systems

■ *Section 1*
General

1.5 Materials

1.5.1 ~~Materials are to comply with the requirements of *Ch 1, 1.6 Materials and fabrication*.~~Derrick systems are to be constructed of steel which complies with the requirements of *Ch 1, 1.6 Materials and fabrication* and *Ch 11 Materials and Fabrication.* Proposals to use materials other than steel will be specially considered. The fabrication is to be in compliance with *Ch 11, 2 Fabrication of classed lifting appliances* or *Ch 11, 3 Fabrication of certified lifting appliances*.

1.5.2 Steel for masts, derrick posts and associated items included in the classification of the hull is to comply with the requirements of the *Rules for the Manufacture, Testing and Certification of Materials*. The steel is to comply with the ~~grade of steel is to comply with the requirements of *Table 2.1.1 Impact grade requirements for classed structures*, or~~ Charpy V-notch impact test requirements given in ~~are to comply with *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel* in Chapter 4 as appropriate~~ *Ch 11, 1.2 General material requirements 1.2.2*, with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation or the lowest temperature of operation for the derrick system (*see Ch 11, 1.2 General material requirements 1.2.4*).

Table 2.1.1 Impact grade requirements for classed structures has been deleted in its entirety.

1.5.3 Steel for derrick booms and associated fittings is to comply with LR's requirements as in *Ch 2, 1.5 Materials 1.5.2* or with ~~an appropriate National~~ a recognised National or International Standard, *see Ch 1, 1.6 Materials and fabrication*.

1.5.6 The required documentation for materials used for the construction of classed and certified derrick systems is defined in *Ch 11, 4 Material documentation for certified and classed lifting appliances*.

Chapter 3
Launch and Recovery Appliances for Survival Craft and Rescue Boats

■ *Section 1*
General

1.11 Materials

1.11.1 Davits, winches and loose gear are to be constructed of steel which complies with the requirements of ~~the Rules for Materials. Alternatively, steels complying with a recognised National or International Standard may be used, provided they give reasonable equivalence to the Rule requirements, *see* *Ch 1, 1.6 Materials and fabrication*~~ and *Ch 11 Materials and Fabrication*. Proposals to use materials other than steel will be specially considered. The fabrication is to be in compliance with *Ch 11, 2 Fabrication of classed lifting appliances* or *Ch 11, 3 Fabrication of certified lifting appliances*.

1.11.2 The selected steel grade is to provide adequate protection against brittle fracture~~, taking into account the material tensile stress, component thickness and the ship's intended service environment, and in general, the materials are~~. The steel is to comply with the Charpy V-notch impact test requirements given in ~~*Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel* in Chapter 4~~ *Ch 11, 1.2 General material requirements 1.2.2*, with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation or the lowest temperature of operation for the derrick system (*see Ch 11, 1.2 General material requirements 1.2.4*).

1.11.3 Where a ship is intended for service in more severe environments (e.g. ~~icebreakers~~ ice breakers in polar waters) the Charpy V-notch impact test requirements will be specially considered based on the minimum service temperature specified.

1.11.4 The required documentation for materials used for the construction of launch and recovery appliances for survival craft and rescue boats is defined in *Ch 11, 4 Material documentation for certified and classed lifting appliances*.

Existing paragraph 1.11.4 has been renumbered 1.11.5.

Chapter 4
Cranes and Submersible Lifting Appliances

■ *Section 2*
Shipboard cranes

2.24 Slewing ring and slewing ring bolting

2.24.7 The slewing rings are to comply with the Charpy V-notch impact test requirements as per ~~*Ch 4, 2.25 Materials 2.25.6*~~ *Ch 4, 2.25 Materials 2.25.4*, as applicable.

2.25 Materials

2.25.1 ~~The crane is to be constructed of steel which complies with LR's requirements for hull structural steel. Alternatively, steels which comply with National specifications may be used, provided these specifications give equivalence to Rule requirement, *see* *Ch 1, 1 Introduction*.~~ Cranes and submersible lifting appliances are to be constructed of steel which complies with the requirements of *Ch 1, 1.6 Materials and fabrication* and *Ch 11 Materials and Fabrication*. Proposals to use materials other than steel will be specially considered. The fabrication is to be in compliance with *Ch 11, 2 Fabrication of classed lifting appliances* or *Ch 11, 3 Fabrication of certified lifting appliances*, as applicable.

2.25.2 The selected steel grade is to provide adequate assurance against brittle fracture. The~~, taking into account the material tensile strength and thickness and the environment in which the crane is designed to operate, *see* *Ch 11 Materials and Fabrication*, and is in general~~ steel is to comply with the Charpy V-notch impact test requirements given in ~~*Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel*, *Table 4.2.18 Charpy V-notch test impact energy requirements for classed and certified lifting appliances* and *Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels*~~. *Ch 11, 1.2 General material*

requirements 1.2.2, with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation or the lowest temperature of operation for the derrick system (*see Ch 11, 1.2 General material requirements 1.2.4*.

Existing Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel has been deleted.

Existing Table 4.2.18 Charpy V-notch test impact energy requirements for classed and certified lifting appliances has been deleted.

Existing Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels has been deleted.

Existing paragraphs 2.25.3 and 2.25.4 have been deleted.

Existing paragraph 2.25.5 has been renumbered 2.25.3.

Existing paragraph 2.25.6 has been renumbered 2.25.4.

2.25.5 The required documentation for materials used for the construction of classed and certified cranes and submersible lifting appliances is defined in *Ch 11, 4 Material documentation for certified and classed lifting appliances*.

■ *Section 3*
Offshore cranes

3.7 Slew rings

(Part only shown)

3.7.8 Slew rings are to be manufactured at works approved by LR under LR survey with the following additional requirements:

(a) Slew ring material in the forged state and final bulk heat treated condition is to be tested to ensure compliance with the requirements of *Ch 4, 2.25 Materials 2.25.3*, ~~and *Ch 4, 2.25 Materials 2.25.5* and~~ *Ch 4, 3.7 Slew rings 3.7.2* and *Ch 11, 1.2 General material requirements 1.2.3*.

3.8 Materials

3.8.1 The requirements for selection of materials and associated impact toughness requirements are given in *Ch 4, 2.25 Materials* and *Ch 11 Materials and Fabrication*.

■ *Section 4*
Submersible handling systems

4.1 General

4.1.1 This Section applies to installations which are designed to launch and recover manned and unmanned submersibles in an open sea environment from ships or semisubmersible vessels. For the purpose of these requirements, the term 'manned submersible handling systems' includes the handling of manned diving systems. Generally, the ~~sea state~~ significant wave height will not exceed 2,0 m ~~Sea State 4~~ for ~~man-~~ manned submersible handling operations, but may be higher for unmanned operations. Special consideration will be given to cases where service in a ~~more severe sea state~~ significant wave height above 2,0 m is envisaged for manned ~~diving~~ submersible operations.

4.1.2 The design requirements of ~~*Ch 4, 2 Shipboard cranes*~~ *Ch 4, 3 Offshore cranes* are to apply to all submersible handling systems except where specific requirements are defined in this Section.

4.1.3 The general requirements for machinery items are provided in *Ch 9 Machinery*. Specific requirements for machinery items engaged in manned submersible handling operations are provided in *Ch 9, 4 Machinery engaged in handling of personnel* and *Ch 9, 5 Hydraulic cylinders* (as applicable). In addition to approving the structural arrangements for manned submersible handling systems, details of the machinery items (e.g. winches (main and secondary), including all torque transmitting components) are to be submitted for approval.

4.1.4~~4.1.3~~ ~~A secondary~~ An alternative (secondary) means of recovery is to be provided for all manned ~~diving~~ submersible handling systems that are dependent on the handling system for regaining the surface. In addition to the main and alternative means of retrieval, an emergency means of retrieval is defined in *Pt 5, Ch 7 Lifting Appliances* of the *Rules and Regulations for the Construction & Classification of Submersibles & Diving Systems*.

~~4.1.4 In addition to approving the structural arrangements for manned diving handling systems, details of the winches (main and secondary), including all torque transmitting components, are to be approved for the intended purpose or are to be submitted for approval.~~

4.2 Service category and duty factor

4.2.1 A duty factor, F_d, of 1,2 is to be used for all submersible handling systems, while the submersible is suspended over the side of the ship or in the moonpool. A reduced duty factor may be considered once the submersible is safely inboard the ship (*see Table 4.4.1 Dynamic factors and design parameters for submersible handling systems*). Alternative proposals to use lower duty factors shall be based on the principles outlined in *Ch 4, 2.3 Duty factor 2.3.2* to *Ch 4, 2.3 Duty factor 2.3.4* and will be specially considered.

4.3 Basic loads

4.3.1 The live load, L_l, to be used for submersible handling systems is to be taken as the greater of:

(a) The maximum in-air weight of the submersible, the in-air weight of items (e.g. the hook) which are connected to the submersible and the exposed length of hoisting rope extending from the winch to the hook.

(b) The maximum weight of the exposed length of hoisting rope extending from the winch to the air/water interface, together with the combined in-water weight of the submersible, the in-water weight of items (e.g. the hook) which are connected to the submersible and the submerged length of hoisting rope extending from the air/water interface to the hook.

The weight of entrained or trapped water needs to be considered for the evaluation of the weight of the submersible.

4.4 Dynamic forces

4.4.1 The hoisting factor, ~~F_h~~ $F_{h,swh}$, to be used for submersible handling systems incorporates the effects of the submersible passing through the ~~water/air~~air/water interface as well as accelerations from ship motions acting on the live load.

4.4.2 Where possible, the ~~hoist~~hoisting factor is to be based on actual accelerations or from model predictions for the mother ship's behaviour, taking into account the ship's headings and the sea conditions.

4.4.3 Where actual accelerations or model predictions are not available, the minimum default values of the ~~hoist~~ hoisting factor, ~~F_h~~ $F_{h,swh}$, for different sea conditions (e.g. significant wave heights) and with the submersible in various positions in the operating cycle are given in *Table 4.4.1 Dynamic factors and design parameters for submersible handling systems*. Values of ~~F_h~~ $F_{h,swh}$ for intermediate significant wave heights can be obtained by interpolation.

4.4.4 Where the design parameters given in *Table 4.4.1 Dynamic factors and design parameters for submersible handling systems* are used, further calculations and/or further (operational) assessment should be carried out, in order to ensure that the design parameters taken from that Table are not exceeded during the actual operation of the submersible handling system, taking into account influences such as vessel accelerations, wind, hoisting factor, heel/trim angle, offlead/sidelead angle, effects of the air/water interface (splash zone), effects of added mass, drag and current forces, seabed suction, etc.

4.4.5 The horizontal components of force derived from the angles of heel, trim, offlead and sidelead are to be multiplied by the hoisting factor appropriate for the phase in the launch and recovery cycle (*see Table 4.4.1 Dynamic factors and design parameters for submersible handling systems*).

4.5 Wind

4.5.1 The design wind speed for operational conditions shall be taken as at least 20 m/s, corresponding to a wind pressure exceeding 250 N/m². Reference is made to the specified service category as defined in *Ch 1, 2.3 Service category 2.3.2*.

4.5.2 The stowage wind speed is to be taken as at least 63 m/s.

4.5.3 Proposals for the application of other wind speeds will be specially considered.

4.5.4 All wind speeds are to be related to gust wind speeds averaged over a duration of 3 seconds.

~~4.5~~4.6 Offlead and sidelead angles

~~4.5.1~~4.6.1 Submersible handling ~~equipment~~ systems ~~operates~~ operate in an ~~open-sea~~ open sea environment where there is significant movement of the ship and/or submersible due to wave action. To allow for these conditions, simultaneously acting ~~an~~ offlead and sidelead ~~angle, assumed to be acting simultaneously, is~~ angles are to be used for design purposes, while the submersible is in the water, passing through the air/water interface, or is in the splash zone. ~~Values~~ Minimum default values for the offlead and sidelead angles to be used for different sea conditions are ~~found~~ given in *Table 4.4.1 Dynamic factors and design parameters for submersible handling systems*.

4.6.2 Where the design parameters given in *Table 4.4.1 Dynamic factors and design parameters for submersible handling systems* are used, further calculations and/or further (operational) assessment should be carried out, in order to ensure that the offlead and sidelead angles as defined in that Table are not exceeded during the actual operation of the submersible handling system.

~~4.6~~4.7 Heel and trim angles

~~4.6.1~~4.7.1 When the submersible is out of the splash zone and in air, the offlead and sidelead angles will not be acting. However, horizontal loads from the effects of the roll and pitch of the mother ship will still need to be considered to be acting on the submersible and self-weight of the handling system. These may be expressed as static angles of heel and trim and ~~typical~~ minimum default values for different sea states are given in *Table 4.4.1 Dynamic factors and design parameters for submersible handling systems*. ~~The horizontal components of force derived from the angles of heel and trim are to be multiplied by the hoist factor appropriate for the phase in the launch and recovery cycle.~~

4.7.2 Where the design parameters given in *Table 4.4.1 Dynamic factors and design parameters for submersible handling systems* are used, further calculations and/or further (operational) assessment should be carried out, in order to ensure that the heel and trim angles as defined in that Table are not exceeded during the actual operation of the submersible handling system. The calculations and/or assessment should further take into account the loads due to vessel motions (e.g. heel and trim, roll and pitch, vessel accelerations).

~~4.7~~4.8 Stowage arrangements

~~4.7.1~~4.8.1 In addition to the operating conditions, the installation is to be designed to withstand the most severe combination of motions which can occur when the handling system is stowed. In the case of ship mounted installations, *see Ch 4, 2.11 Forces due to ship motion*.

4.8.2 The loads originating from the submersible being stowed in the submersible handling system need to be considered.

~~4.7.2~~4.8.3 The effects of 'green sea loading' on the structure will be subject to special consideration ~~if required~~.

~~4.8~~4.9 Materials

~~4.8.1~~4.9.1 Materials for submersible handling systems are to comply with the requirements of *Ch 4, 2.25 Materials*, *Ch 4, 3.8 Materials* and *Ch 11 Materials and Fabrication*.

4.9.2 If slewing rings are applied in the design of the submersible handling system, they are to comply with *Ch 4, 3.7 Slew rings*.

~~4.9~~4.10 Rope safety factors

~~4.9.1~~4.10.1 The minimum safety ~~factor~~ factors, $SF_{\text{swh,steel}}$ and $SF_{\text{swh,synthetic}}$, for ropes used for manned submersibles is to be taken as 8,0 for steel wire ropes and 10,0 for ~~man-made~~ synthetic fibre ropes. Where manned ~~diving~~ submersible operations take place in conditions in ~~excess of Sea State 4~~ which the significant wave height exceeds 2,0 m, where the ~~hoist~~ hoisting factor, ~~F_h~~ $F_{\text{h,swh}}$, is greater than 1,7, the rope safety factor is to be increased as follows:

~~$SF_{SWR} = 8{,}0 \times \frac{F_h}{1{,}7}$ for steel wire ropes, or~~

$SF_{\text{swh,steel}} = 8{,}0\,\frac{F_{\text{h,swh}}}{1{,}7}$ for steel wire ropes, or

~~$SF_{synthetic} = 10 \times \frac{F_h}{1{,}7}$ for synthetic fibre ropes.~~

$SF_{\text{swh,synthetic}} = 10{,}0\,\frac{F_{\text{h,swh}}}{1{,}7}$ for synthetic fibre ropes

~~4.9.2~~4.10.2 The minimum safety factor, $SF_{\text{swh,steel}}$, for wire ropes used for unmanned submersibles for SWL greater than 10 t and less than 160 t is to be determined from the following expression:

$$SF_{\text{swh,steel}} = \frac{10^4}{\frac{200}{27}\,\text{~~SWL~~SWL} + \frac{43000}{27}}\,\frac{F_{\text{h,swh}}}{1{,}7}$$

where

$SF_{\text{swh, steel}}$ = minimum safety factor for steel wire rope required at significant wave height (swh)

$F_{\text{h,swh}}$ = hoisting factor at a specific swh derived in accordance with *Ch 4, 4.4 Dynamic forces*

~~SWL~~SWL= safe working load of the submersible handling system, in tonnes

For submersible handling systems with ~~SWL~~SWL $\leq$ ~~10t~~ 10 t, $SF_{\text{swh,steel}} = 6{,}0\,\frac{F_{\text{h,swh}}}{1{,}7}$;

and ~~SWL~~SWL $\geq$ ~~160t~~ 160 t, $SF_{\text{swh,steel}} = 3{,}6\,\frac{F_{\text{h,swh}}}{1{,}7}$.

The factor $\frac{F_{\text{h,swh}}}{1{,}7}$ is not to be taken as less than 1,0.

~~4.9.3~~4.10.3 The minimum safety factor, $SF_{\text{swh,synthetic}}$, for ~~man-made~~ synthetic fibre ropes used for unmanned submersibles is to be obtained from *Ch 4, ~~4.9~~ 4.10 Rope safety factors ~~4.9.2~~4.10.2*, multiplied by 1,25.

~~4.9.4~~4.10.4 If in addition to the primary ~~hoist~~hoisting rope, ~~a secondary~~ an alternative (secondary) system of recovery is employed using another ~~hoist~~hoisting rope, the minimum safety factor for this rope is to be not less than $\sim\!\!5{,}0\frac{F_{\text{h,swh}}}{1{,}7}$ $SF_{\text{swh,steel,secondary}} = 5{,}0\frac{F_{\text{h,swh}}}{1{,}7}$ for steel wire rope and $\sim\!\!6{,}25\frac{F_{\text{h,swh}}}{1{,}7}$ $SF_{\text{swh,synthetic,secondary}} = 6{,}25\frac{F_{\text{h,swh}}}{1{,}7}$ for synthetic fibre rope. The factor $\frac{F_{\text{h,swh}}}{1{,}7}$ is not to be taken as less than 1,0.

~~4.10~~4.11 Transfer systems

~~4.10.1~~4.11.1 Cradles and their rails that are used to transfer diving bells or manned submersibles from the deck to the ~~transfer-underpressure~~Transfer Under Pressure (TUP) facilities are to be designed in accordance with *Ch 4, 2 Shipboard cranes*, taking due account of the accelerations from ship motions, in both the operational and survival conditions.

~~4.11~~4.12 Testing

~~4.11.1~~4.12.1 The load testing requirements for manned ~~diving~~ submersible handling systems are given in *Ch 12, 1.7 ~~Launch and recovery systems for diving operations~~ Manned submersible handling systems*.

Existing paragraph 4.11.2 has been renumbered 4.12.2.

Table 4.4.1 Dynamic factors and design parameters for submersible handling systems

Position in launch/ recovery cycle		Significant wave height 0,6 m				~~Sea state 4~~ Significant wave height 2,0 m				~~Sea state 5 - 6~~ Significant wave height 3,9 m				~~Sea state 6~~ Significant wave height 5,0 m				~~Sea state 7~~ Significant wave height 7,0 m			
		Manned or unmanned operation				Manned or unmanned operation				Unmanned operation				Unmanned operation				Unmanned operation			
	F_{-d}	F_{h}	Heel	Trim	Offlead/ Sidelead	F_{-h}	Heel	Trim	Offlead/ Sidelead	F_{-h}	Heel	Trim	Offlead/ Sidelead	F_{-h}	Heel	Trim	Offlead/ Sidelead	F_{-h}	Heel	Trim	Offlead/ Sidelead
	[1]	[1]	[°]	[°]	[°]	[1]	[°]	[°]	[°]	[1]	[°]	[°]	[°]	[1]	[°]	[°]	[°]	[1]	[°]	[°]	[°]
Submerged – near surface	1,2	1,3	5 *see* Note 1	2 *see* Note 1	10/10 *see* Note 2	1,7	6 *see* Note 1	3 *see* Note 1	10/10 *see* Note 2	~~2,25~~ 2,3	8 *see* Note 1	4 *see* Note 1	10/10 *see* Note 2	2,5	10 *see* Note 1	5 *see* Note 1	10/10 *see* Note 2	~~2,72~~ 2,8	12 *see* Note 1	6 *see* Note 1	12/12 *see* Note 2
~~Air/water interface~~ Air/water interface *see* Note 4	1,2	1,3	5 *see* Note 1	2 *see* Note 1	10/10 *see* Note 2	1,7	6 *see* Note 1	3 *see* Note 1	10/10 *see* Note 2	~~2,25~~ 2,3	8 *see* Note 1	4 *see* Note 1	10/10 *see* Note 2	2,5	10 *see* Note 1	5 *see* Note 1	10/10 *see* Note 2	~~2,72~~ 2,8	12 *see* Note 1	6 *see* Note 1	12/12 *see* Note 2
Outboard ~~on rope~~ unlatched	1,2	1,3	5 *see* Note 3	2 *see* Note 3	–	1,6	6 *see* Note 3	3 *see* Note 3	–	2,1	8 *see* Note 3	4 *see* Note 3	–	2,3	10 *see* Note 3	5 *see* Note 3	–	2,5	12 *see* Note 3	6 *see* Note 3	–
~~Outboard – latched~~ Outboard – latched	1,2	1,3	5 *see* Note 3	2 *see* Note 3	–	1,4	6 *see* Note 3	3 *see* Note 3	–	1,7	8 *see* Note 3	4 *see* Note 3	–	~~1,85~~ 1,9	10 *see* Note 3	5 *see* Note 3	–	2,0	12 *see* Note 3	6 *see* Note 3	–
~~Inboard latched~~ Inboard – latched	1,05	1,3	5 *see* Note 3	2 *see* Note 3	–	1,3	6 *see* Note 3	3 *see* Note 3	–	1,5	8 *see* Note 3	4 *see* Note 3	–	1,6	10 *see* Note 3	5 *see* Note 3	–	1,7	12 *see* Note 3	6 *see* Note 3	–
~~Deck lifts unlatched~~ Deck lifts – unlatched	1,05	1,3	5 *see* Note 3	2 *see* Note 3	–	1,3	6 *see* Note 3	3 *see* Note 3	–	1,5	8 *see* Note 3	4 *see* Note 3	–	1,6	10 *see* Note 3	5 *see* Note 3	–	1,7	12 *see* Note 3	6 *see* Note 3	–

Note 1. Heel and trim to be applied to self-weight components only.
Note 2. Offlead and sidelead angles to be applied to the suspended load.
Note 3. Heel and trim to be applied to both suspended load and self-weight components.
Note 4. Any favourable buoyancy effect on the load shall not be considered.
Note Intermediate values can be obtained by interpolation.

■ *Section 5*

Pedestals and ~~foundation~~ foundations

5.1 General

5.1.1 ~~Crane pedestals~~ Pedestals and foundations for ship-mounted ~~cranes~~ lifting appliances are ~~a~~ classification items. Pedestals and foundations on offshore installations will be considered on the same basis as the main support structure, as required by the coastal state authority or regulatory body.

5.1.2 The loading conditions as defined in *Ch 4, 2 Shipboard cranes*, *Ch 4, 3 Offshore cranes* and *Ch 4, 4 Submersible handling systems* are to be applied in association with the allowable stress levels contained in this Section. Pedestals and foundations for lifting appliances other than shipboard cranes, offshore cranes or submersible handling systems will be specially considered on the basis of this Section, as applicable.

5.1.6 This Section covers a pedestal structure which is not part of the hull or main support structure of the pedestal. The hull or main support structure is to be designed as per ~~LR's *Rules and Regulations for the Classification of Ships, July 2021, incorporating Notice No. 1, 2, 3, 4 & 5*.~~ the applicable LR's Rules for ship types or offshore units. *See also Ch 1, 1.1 Application 1.1.13* to determine which parts of pedestals and foundations are covered by which LR requirements.

5.2 Design loads

5.2.1 The pedestal is to be designed with respect to the worst possible combination of loads as detailed in the applicable parts of *Ch 4, 2 Shipboard cranes*, *Ch 4, 3 Offshore cranes* and *Ch 4, 4 Submersible handling systems*. Pedestals and foundations for lifting appliances other than shipboard cranes, offshore cranes or submersible handling systems will be specially considered on the basis of this Section, as applicable.

5.3 Allowable stresses

(Part only shown)

5.3.4 As an alternative to the stress factors F_p as defined in *Table 4.5.1 Stress factor, F_p*, the stress factors as defined in *Table 4.5.2 Alternative stress factor, F_p* can be applied, provided all of the following conditions are fulfilled:

(d) The structural integration of the ~~crane~~ lifting appliance pedestal into the supporting ship structure is to be verified where required, taking into account the global hull girder stresses for the corresponding loading condition (still water loads and wave loading if applicable) and superimposing the stresses resulting from the ~~crane~~ lifting appliance operation.

The graphical representation of *Table 4.5.2 Alternative stress factor, F_p* has been provided in *Figure 4.5.1 Stress factor, F_p*.

5.4 Materials

5.4.1 ~~Crane~~Lifting appliance pedestals and foundations are to be constructed of ~~steels~~ steel which ~~conform to~~ complies with LR's *Rules for the Manufacture, Testing and Certification of Materials* and the ~~*Rules and Regulations for the Classification of Mobile Offshore Units*~~ *Rules and Regulations for the Classification of Mobile Offshore Units*, as appropriate.

5.4.2 ~~The grade of steel for pedestals of ship-mounted cranes is to be selected in accordance with LR steel grades equivalent to *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel*, *Table 4.2.18 Charpy V-notch test impact energy requirements for classed and certified lifting appliances* and *Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels* (as applicable) with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation, or the defined minimum design temperature for the crane in operation.~~ The selected steel grade is to provide adequate assurance against brittle fracture. The steel is to comply with the Charpy V-notch impact test requirements given in *Ch 11, 1.2 General material requirements 1.2.2*, with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation or the lowest temperature of operation for the derrick system (*see Ch 11, 1.2 General material requirements 1.2.4*).

5.4.3 The grade of steel for pedestals and foundations on offshore installations or manned submersible handling installations is to comply with the requirements of *Ch 4, 3.8 Materials* and/or the requirements of the coastal state authority, as applicable.

■ *Section 7*
Launch and recovery appliances for manned small watercraft

7.1 General

(Part only shown)

7.1.5 The requirements of this Section are considered appropriate for launch and recovery operations carried out under the following conditions:

(d) minimum design ~~temperatures~~ temperature is higher than -40°C (*see ~~Ch 4, 2.25 Materials 2.25.3~~ Ch 11, 1.2 General material requirements 1.2.4*);

Note: Existing sub-Section 7.7 has been deleted as the content has been moved to Chapter 1 to be applicable to all lifting and life-saving appliances covered under this code.

Existing sub-Sections 7.8 to 7.10 have been renumbered 7.7 to 7.9.

■ *Section 8*
Launch and recovery appliances for unmanned small watercraft

8.1 General

(Part only shown)

8.1.3 The requirements of this Section are considered appropriate for launch and recovery operations carried out under the following conditions:

(d) minimum design temperature is higher than -40°C (*see ~~Ch 4, 2.25 Materials 2.25.3~~ Ch 11, 1.2 General material requirements 1.2.4*);

Chapter 5
Shiplift and Transfer Systems

■ *Section 3*
Materials of construction

3.1 Materials for certified installations

~~3.1.1 Materials intended for the construction of lifting appliances are to be in accordance with recognised National or International Standards that include materials which are equivalent to those specified in the *Rules for the Manufacture, Testing and Certification of Materials*, but where the approval and survey requirements do not comply with the requirements of *Ch 1 General Requirements* of the *Rules for the Manufacture, Testing and Certification of Materials* and Section 1 of subsequent Chapters of the *Rules for the Manufacture, Testing and Certification of Materials*, as appropriate, materials may be subject to additional testing under LR Survey prior to acceptance for any project.~~

3.1.1 Certified shiplift and transfer systems are to be constructed of steel which complies with the requirements of *Ch 1, 1.6 Materials and fabrication* and *Ch 11 Materials and Fabrication*. Proposals to use materials other than steel will be specially considered. The fabrication is to be in compliance with *Ch 11, 3 Fabrication of certified lifting appliances*, as applicable.

3.1.2 The requirements with respect to toughness criteria are the same as for classed installations, *see Ch 5, 3.2 Materials for classed installations 3.2.3* and *Ch 5, 3.2 Materials for classed installations 3.2.4* ~~and *Table 5.5.2 Failure stress*~~.

~~3.1.3 Structural steel in the primary load path, including pins and wheels, is to be supplied with a manufacturer's certificate, as defined in *Ch 1, 3 Certification of materials* of the *Rules for the Manufacture, Testing and Certification of Materials*. This certificate is equivalent to inspection certificate 3.1 as per the requirements of EN 10204 *Metallic products – Types of inspection documents* or ISO 10474 *Steel and steel products – Inspection documents*, issued by the manufacturer of the materials.~~

3.1.3 The required documentation for materials such as structural steel in the primary load path (including pins and wheels) used for the construction of certified shiplift and transfer systems is to be as defined in *Ch 11, 4 Material documentation for certified and classed lifting appliances*.

3.2 Materials for classed installations

~~3.2.1 The materials used in the construction of classed shiplifts and transfer systems are to be manufactured and tested in accordance with the requirements of the *Rules for the Manufacture, Testing and Certification of Materials*. Materials for which provision is not made therein may be accepted, provided that the requirements as defined in *Ch 1, 1 Introduction 1.6.1 (b)* are complied with.~~

3.2.1 Classed shiplift and transfer systems are to be constructed of steel which complies with the requirements of *Ch 1, 1.6 Materials and fabrication* and *Ch 11 Materials and Fabrication*. Proposals to use materials other than steel will be specially considered. The fabrication is to be in compliance with *Ch 11, 2 Fabrication of classed lifting appliances*.

~~3.2.2 Structural steel in the primary load path, including pins and wheels, are to be supplied with an LR certificate or a manufacturer's certificate validated by LR, as defined in *Ch 1, 3 Certification of materials* of the *Rules for the Manufacture, Testing and Certification of Materials*.~~

3.2.2 The required documentation for materials such as structural steel in the primary load path (including pins and wheels) used for the construction of classed shiplift and transfer systems is to be as defined in *Ch 11, 4 Material documentation for certified and classed lifting appliances*.

3.2.3 The selected steel grade is to provide adequate assurance against brittle fracture and ~~Steel for the primary strength members~~ is to comply with *Ch 11, 1.2 General material requirements 1.2.2*~~.~~

~~• *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel*;~~

~~• *Table 4.2.18 Charpy V-notch impact test energy requirements for classed and certified lifting appliances*; and~~

~~• *Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels*.~~

The Charpy V-notch impact test requirements for minimum design temperatures above -10°C and below -40°C will be specially considered (*see Ch 11, 1.2 General material requirements 1.2.4*).

Chapter 6
Ro-Ro Access Equipment

■ *Section 2*
Loading and design criteria

2.13 Materials

2.13.1 ~~Materials are to comply with the requirements of *Ch 1, 1.6 Materials and fabrication*.~~ Ro-Ro access equipment is to be constructed of steel which complies with the requirements of *Ch 1, 1.6 Materials and fabrication* and *Ch 11 Materials and Fabrication*. Proposals to use materials other than steel will be specially considered. The fabrication is to be in compliance with *Ch 11, 2 Fabrication of classed lifting appliances* or *Ch 11, 3 Fabrication of certified lifting appliances*.

2.13.2 ~~Where the Ro-Ro equipment is a classification item, the grade of steel selected in accordance with *Table 2.1.1 Impact grade requirements for classed structures* in Chapter 2.~~The selected steel grade is to provide adequate assurance against brittle fracture. The steel is to comply with the Charpy V-notch impact test requirements given in *Ch 11, 1.2 General material requirements 1.2.2*, with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation or the lowest temperature of operation for the Ro-Ro access equipment (*see Ch 11, 1.2 General material requirements 1.2.4*).

2.13.3 ~~Where the Ro-Ro equipment is subject to certification only, the selected steel grade is to provide adequate assurance against brittle fracture taking into account the material tensile strength and thickness and the environment in which the Ro-Ro equipment is designed to operate and, in general, is to comply with the Charpy test requirements given in *Table 4.2.17 Charpy Vnotch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel* in *Ch 4 Cranes and Submersible Lifting Appliances*.~~The required documentation for materials used for the construction of classed and certified Ro-Ro access equipment is defined in *Ch 11, 4 Material documentation for certified and classed lifting appliances*.

Chapter 7
Lifts

■ *Section 2*
Passenger lifts

2.1 General

Existing paragraph 2.1.8 has been deleted and replaced with below:

2.1.8 Lifts are to be constructed of steel which complies with the requirements of *Ch 1, 1.6 Materials and fabrication* and *Ch 11 Materials and Fabrication*. Proposals to use materials other than steel will be specially considered. The fabrication is to be in compliance with *Ch 11, 2 Fabrication of classed lifting appliances* or *Ch 11, 3 Fabrication of certified lifting appliances*.

2.1.9 The selected steel grade is to provide adequate assurance against brittle fracture. The steel is to comply with the Charpy V-notch impact test requirements given in *Ch 11, 1.2 General material requirements 1.2.2*. Alternative proposals in respect of the notch toughness characteristics of the materials will be considered when the environmental condition of the particular installation is such that there is a low probability of low temperatures.

2.1.10 The required documentation for materials used for the construction of classed and certified lifts is defined in *Ch 11, 4 Material documentation for certified and classed lifting appliances*.

Chapter 8
Fittings, Loose Gear and Ropes

■ *Section 1*
General

1.2 Materials and construction

1.2.1 Materials are to comply with the requirements of *Ch 1, 1.6 Materials and fabrication* and *Ch 11 Materials and Fabrication*.

~~1.2.2 Steel for bearing brackets and other items welded to the ship's structure (including to the masts, derrick posts and crane pedestals) is, generally, to comply with the requirements of the *Rules for the Manufacture, Testing and Certification of Materials* (hereinafter referred to as the Rules for Materials). The grade of steel is to be selected in accordance with LR steel grades equivalent to *Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel* and *Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels* in Chapter 4, with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation or the defined minimum design temperature for the crane in operation.~~

1.2.2 The selected steel grade is to provide adequate assurance against brittle fracture and is to comply with *Ch 11, 1.2 General material requirements 1.2.2,* with the operating temperature chosen as being the lesser of either that from an assigned winterisation notation or the lowest temperature of operation for the lifting appliance (*see Ch 11, 1.2 General material requirements 1.2.4*).

~~1.2.3 Steel for other items is to comply with LR's requirements as in *Ch 8, 1.2 Materials and construction 1.2.2* or with an appropriate National Standard approved by LR as suitable for the intended purpose, *see also Ch 1, 1.6 Materials and fabrication*.~~

1.2.3 Steel for bearing brackets and other items welded to the ship's structure (including to the masts, derrick posts and crane pedestals) is, generally, to comply with the requirements of the *Rules for the Manufacture, Testing and Certification of Materials*.

1.2.4 Steel for other items not welded to the ship's structure is to comply with LR's requirements as in *Ch 8, 1.2 Materials and construction 1.2.2* or with an appropriate National or International Standard recognised by LR as suitable for the intended purpose. For routes to achieve materials compliance for classed or certified applications *see also Ch 1, 1.6 Materials and fabrication*.

Existing sub-Sections 1.2.4 to 1.2.9 have been renumbered 1.2.5 to 1.2.10.

1.2.11 The required documentation for materials used for the construction of fittings, loose gear and ropes associated with classed and certified lifting appliances is defined in *Ch 11, 4 Material documentation for certified and classed lifting appliances*.

■ *Section 3*
Blocks

3.3 Materials and construction

3.3.1 Sheaves may be forged or fabricated from steel plate. In general, castings in steel or spheroidal graphite iron may be accepted, but grey cast iron or malleable cast iron is not to be used for sheaves ~~in the following circumstances~~ unless specially agreed~~:~~.

~~(a) Single sheave block having SWL greater than 10 t.~~

~~(b) Multiple sheave block having SWL greater than 20 t.~~

~~(c) Any block in the rig of a lifting appliance having SWL greater than 20 t.~~

3.3.5 Side and partition plates and straps are to be steel castings or fabricated from steel plate. ~~Malleable cast iron may be used when permitted for sheaves, *see Ch 8, 3.3 Materials and construction 3.3.1*.~~ The plates are to project beyond the sheaves to provide ample protection for the rope. Means are to be provided to prevent the rope from jamming between the sheave and the side or partition plates by minimising the clearance or by fitting suitable guards.

3.3.7 Crossheads and beckets may be steel cast, forged or machined from plate.

■ *Section 4*
Spreaders and lifting beams

4.1 General

4.1.2 Steel used in the construction of the beam is to be of weldable quality in accordance with *Ch 8, 1.2 Materials and construction*. The grade of steel is to be selected in accordance with ~~*Table 4.2.17 Charpy V-notch impact test temperature requirements for welded primary and secondary steel structure. Excludes stainless steel*~~, ~~*Table 4.2.18 Charpy V-notch test impact energy requirements for classed and certified lifting appliances*~~ and ~~*Table 4.2.19 Charpy V-notch impact test temperature requirements for non-welded components (excluding slew bearings) subject to tensile loading. Excludes stainless steels*~~ in ~~Chapter~~ 4 the requirements as provided in *Ch 11, 1.2 General material requirements 1.2.2*, based on the minimum design temperature for the location where the beam will be used (*see Ch 11, 1.2 General material requirements 1.2.4*).

Chapter 9
Machinery

■ *Section 2*
Design and construction of machinery

2.2 Materials

2.2.1 The materials applied are to be in compliance with *Ch 1, 1.6 Materials and fabrication*, *Ch 11 Materials and Fabrication* and relevant ~~sections~~Sections related to materials in the individual Chapters. The fabrication is to be in compliance with ~~*Ch 11 Materials and Fabrication*~~ *Ch 11, 2 Fabrication of classed lifting appliances* or *Ch 11, 3 Fabrication of certified lifting appliances*.

2.2.3 In cases where machinery is exposed to the environment, demonstration of a material's suitability for operations at low temperature is required. For the definition of the minimum design temperature *see Ch 11, 1.2 General material requirements 1.2.4*. High strength structural steels are to be in compliance with the impact test requirements as listed in ~~*Ch 4, 2.25 Materials*~~ *Ch 11, 1.2 General material requirements 1.2.2*. Machinery components fabricated from alloy steels such as 42CrMo4QT and 34CrNiMo6QT are to be in compliance with *Ch 4, 2.25 Materials 2.25.2* and impact tested as per ~~*Ch 4, 2.25 Materials 2.25.6*~~ *Ch 4, 2.25 Materials 2.25.4*.

Existing paragraph 2.2.4 has been deleted in its entirety.

■ *Section 4*
Machinery engaged in handling of personnel

4.1 Scope

4.1.2 This Section does not cover the requirements for lifting appliances intended for ~~manned diving operations,~~ shiplift and transfer systems, ro-ro access equipment and lifts.

Chapter 11
Materials and Fabrication

Existing Section 1 has been deleted and replaced with the below:

■ *Section 1*
General requirements

1.1 Scope

1.1.1 Provision is made in this Chapter for requirements related to materials, fabrication and related inspection of classed and certified lifting appliances.

1.1.2 The material properties are to comply with the requirements given in the relevant Chapter dealing with design and/or shown on the approved plan.

1.1.3 Detailed requirements for the testing and inspection of steel wire rope and fibre rope are given in *Ch 8 Fittings, Loose Gear and Ropes*.

1.1.4 Proposals to use synthetic materials are to be submitted for consideration.

1.1.5 Special consideration by LR is required for a selected material which is proposed to be applied to the actual project and which is not defined in the *Rules for the Manufacture, Testing and Certification of Materials* or in this Code, *see Ch 1, 1.6 Materials and fabrication 1.6.7*. Reference is made to LR's *Guidance Notes for Special Consideration Process for Materials Applications*.

1.1.6 Requirements for the fabrication and inspection of classed lifting appliances are specified in *Ch 11, 2 Fabrication of classed lifting appliances*.

1.1.7 Requirements for the fabrication of certified lifting appliances are specified in *Ch 11, 3 Fabrication of certified lifting appliances*.

1.1.8 Requirements for material documentation for classed and certified lifting appliances are specified in *Ch 11, 4 Material documentation for certified and classed lifting appliances*.

1.2 General material requirements

1.2.1 Materials used for the construction, or repair, of lifting appliances are to be manufactured and tested in accordance with the general procedures given in this Chapter and in *Ch 1, 1.6 Materials and fabrication*.

1.2.2 The selected steel grade is to provide adequate assurance against brittle fracture, taking into account the material tensile strength and thickness and the environment in which the lifting appliance is designed to operate, with the operating temperature chosen being the lesser of either that from an assigned winterisation notation or the lowest temperature of operation for the lifting appliance (*see Ch 11, 1.2 General material requirements 1.2.4*). Charpy V-notch impact test requirements are to comply with the following tables:

- *Table 11.1.1 Charpy V-notch impact test temperature requirements for welded steel structure with a minimum specified yield strength up to 690 MPa (excludes stainless steels)*;
- *Table 11.1.2 Charpy V-notch impact test temperature requirements for non-welded components with a minimum specified yield strength up to 960 MPa*;
- *Table 11.1.3 Charpy V-notch impact test temperature requirements for welded steel structures with a minimum specified yield strength up to 960 MPa (excludes stainless steel)*; and
- *Table 11.1.4 Charpy V-notch impact test energy requirements for welded and non-welded steel structure with a material strength higher than 690*.

The different categories of structural components used in the above tables are defined as follows:

(a) Critical structural component is a structural member of the lifting appliance where the failure of which will result in the loss of the lifting appliance or the load being lifted, e.g. pedestal, slewing bearing, slewing column or a-frame or mast, crane jib, etc.;

(b) Primary structural component is a structural member of the lifting appliance where the failure of which may lead to the loss of the load being lifted, e.g. panel stiffeners to jib or slewing column;

(c) Secondary structural component is a structural component which is not a critical or primary structural component, e.g. service fittings (electrics, lighting).

1.2.3 Critical and primary structural components shall be considered for susceptibility to hydrogen embrittlement due to the corrosive offshore environment. A method for the determination of the susceptibility to hydrogen embrittlement/cracking is provided in EN ISO 17642-1 *Destructive tests on welds in metallic materials - Cold cracking tests for weldments - Arc welding processes – Part 1: General*, EN ISO 17642-2 *Destructive tests on welds in metallic materials - Cold cracking tests for weldments - Arc welding processes – Part 2: Self-restraint tests* and EN ISO 17642-3 *Destructive tests on welds in metallic materials - Cold cracking tests for weldments - Arc welding processes – Part 3: Externally loaded tests*.

Table 11.1.1 Charpy V-notch impact test temperature requirements for welded steel structure with a minimum specified yield strength up to 690 MPa (excludes stainless steels)

Thickness, mm	Minimum design temperature, *see* Note 1							
	–10°C *see* Note 2		–20°C		–30°C		–40°C	
	Required impact test temperature, *see* Note 5							
	Critical/ primary structural component	Secondary structural component	Critical/ primary structural component	Secondary structural component	Critical/ primary structural component	Secondary structural component	Critical/ primary structural component	Secondary structural component
$t \leq 10$	0°C	+20°C	0°C	+20°C	–20°C	–20°C	–20°C	–20°C
	see Note 3	*see* Note 3		*see* Note 3				
$10 < t \leq 20$	0°C	+20°C	–20°C	0°C	–20°C	–20°C	–40°C	–20°C
	see Note 3	*see* Note 3						
$20 < t \leq 25$	0°C	0°C	–20°C	0°C	–40°C	–20°C	–40°C	–20°C
$25 < t \leq 30$	–20°C	0°C	–40°C	–20°C	–40°C	–20°C	–40°C	–40°C
$30 < t \leq 40$	–20°C	0°C	–40°C	–20°C	–40°C	–20°C	–60°C	–40°C
$40 < t \leq 50$	–20°C	0°C	–40°C	–20°C	–60°C	–20°C	–60°C	–40°C
$50 < t \leq 60$	–40°C	–20°C	–60°C *see* Note 4	–20°C	–60°C	–40°C	–60°C	–40°C
$60 < t \leq 150$	–40°C	–20°C	–60°C *see* Note 4	–20°C	–60°C	–40°C	–60°C	–40°C

Note *1*. For intermediate design temperatures the next lowest design temperature shown in the Table is to be selected.

Note *2*. Worldwide service refers to minimum design temperature –10°C or above.

Note *3*. For carbon steels up to minimum specified yield strength of 235 N/mm^2, impact testing is not required unless the carbon content is above 0,23% and/or manganese content is below 2,5 x carbon content, in which case impact tests are to be carried out at +20°C.

Note *4*. For carbon and carbon manganese steels with a minimum specified yield strength of 355 N/mm^2 or below, the test temperature need not be taken lower than –40°C for plates delivered in the normalised condition only.

Note *5*. The Charpy V-notch impact energy requirements are to comply with *Table 11.1.4 Charpy V-notch impact test energy requirements*.

Table 11.1.2 Charpy V-notch impact test temperature requirements for non-welded components with a minimum specified yield strength up to 960 MPa

Thickness, mm	Minimum design temperature, *see* Note 2							
	–10°C *see* Note 3		–20°C		–30°C		–40°C	
	Required impact test temperature, *see* Note 1 and 4							
	Critical/ primary structural component	Secondary structural component	Critical / primary structural component	Secondary structural component	Critical / primary structural component	Secondary structural component	Critical / primary structural component	Secondary structural component

$t \leq 10$	Not required	Not required	0°C	Not required	–10°C	Not required	–20°C	0°C
$10 < t \leq 50$	0°C	Not required	–10°C	Not required	–20°C	0°C	–30°C	–10°C
$50 < t \leq 100$	–10°C	Not required	–20°C	0°C	–30°C	–10°C	–40°C	–20°C
$t > 100$	–20°C	0°C	–30°C	–10°C	–40°C	–20°C	–50°C	–30°C

Note *1*. Slewing bearings are not covered by this Table. *See Ch 4, 2.25 Materials* and *Ch 4, 3.7 Slew rings*.
Note *2*. For intermediate design temperatures the next lowest design temperature shown in the Table is to be selected.
Note *3*. Worldwide service refers to minimum design temperature of –10°C or above.
Note *4*. For cast and forged components, the minimum specified average energy for Charpy V-notch impact tests is to be at least 27 J. For rolled products the Charpy V-notch impact energy requirements are to comply with *Table 11.1.4 Charpy V-notch impact test energy requirements*.

Table 11.1.3 Charpy V-notch impact test temperature requirements for welded steel structures with a minimum specified yield strength up to 960 MPa (excludes stainless steel)

Thickness, mm	Minimum design temperature			
	-10°C		-20°C	
	Required impact test temperature, *see* Note 1			
	Critical/primary structural component	Secondary structural component	Critical/primary structural component	Secondary structural component
$t \leq 10$	−20°C	0°C	−20°C	0°C
$10 < t \leq 20$	−20°C	0°C	−20°C	0°C
$20 < t \leq 25$	−20°C	0°C	−20°C	0°C
$25 < t \leq 30$	−40°C	−20°C	−40°C	−20°C
$30 < t \leq 40$	−40°C	−20°C	−60°C	−40°C

Note 1. The Charpy V-notch impact energy requirements are to comply with *Table 11.1.4 Charpy V-notch impact test energy requirements*.

Table 11.1.4 Charpy V-notch impact test energy requirements

Minimum specified yield stress (N/mm^2)	Minimum average impact energy (J)	Sampling direction
235	27	*L*
275	31	*L*
355	34	*L*
460	40 (30)	*L* (*T*)
690	40 (30)	*L* (*T*)
890	69 (46)	*L (T)*
960	69 (46)	*L (T)*

1.2.4 The purchaser is to specify the lowest temperature of operation. The minimum design temperature is to be taken as 10°C above the lowest temperature of operation. For worldwide service the lowest temperature of operation is to be taken as –20°C with corresponding minimum design temperature of –10°C.

1.2.5 Where it can be shown that satisfactory service experience exists using the particular materials and construction, special consideration may be given to proposals to use materials which do not meet the requirements of:

- *Table 11.1.1 Charpy V-notch impact test temperature requirements for welded steel structure with a minimum specified yield strength up to 690 MPa (excludes stainless steels)*;
- *Table 11.1.2 Charpy V-notch impact test temperature requirements for non-welded components with a minimum specified yield strength up to 960 MPa*;
- *Table 11.1.3 Charpy V-notch impact test temperature requirements for welded steel structures with a minimum specified yield strength up to 960 MPa (excludes stainless steel)*; and
- *Table 11.1.4 Charpy V-notch impact test energy requirements*.

1.2.6 Resistance against brittle fracture for minimum design temperatures below -40°C will be specially considered.

1.2.7 The welding consumables are to be suitable for the type of joint and grade of material to be welded and are, in general, to match the parent material. For base material grades with minimum specified yield strength level of 890 N/mm^2 and 960 N/mm^2, the

weld metal strength may be lower than the minimum specified for the base metal provided that this is taken into account in the design calculations and is clearly marked on the design drawings submitted for approval.

1.2.8 Stainless steels which are acceptable in certified lifting appliance applications under defined conditions have been provided in *Table 11.1.5 Acceptable stainless steels under defined conditions*. Acceptance of these steels in classed applications will be specially considered. Further stainless steels acceptable in certified and classed applications are provided in the *Rules for the Manufacture, Testing and Certification of Materials*.

Table 11.1.5 Acceptable stainless steels under defined conditions

Comparable designations					Application (classed/ certified lifting appliances)	Application limitation	Alloy	Minimum design temperature (°C)
Number (acc. to EN 10088)	ISO number (acc. to ISO 15510)	ISO name (acc. to ISO 15510)	Type (acc. AISI and/or LR)	UNS (acc. to ASTM A959)				
1.4057	4057-431-00-X	X17CrNi16-2	431	S43100	Certified *see* Note 6	Unwelded *see* Notes 1, 2	Martensitic	*see* Note 5
1.4301	4301-304-00-I	X5CrNi18-9	304 *see* Note 8	S30400	Classed and certified *see* Note 7	Unwelded *see* Note 3	Austenitic	-60
1.4306	4306-304-03-I	X2CrNi19-11	304L *see* Note 8	S30403	Classed and certified *see* Note 7	Unwelded *see* Note 3	Austenitic	-60
1.4307	4307-304-03-I	X2CrNi18-9	304L *see* Note 8	S30403	Classed and certified *see* Note 7	Unwelded *see* Note 3	Austenitic	-60
1.4311	4311-304-53-I	X2CrNiN18-10 X2CrNiN18-9	304LN *see* Note 8	S30453	Classed and certified *see* Note 7	Unwelded *see* Note 3	Austenitic	-60
1.4362	4362-323-04-I	X2CrNiN23-4	SS2327	S32304	Certified *see* Note 6	Unwelded and welded *see* Note 3	Duplex	-20
1.4401	4401-316-00-I	X5CrNiMo17-12-2	316	S31600	Certified *see* Note 6	Unwelded *see* Note 3	Austenitic	-60
1.4404	4404-316-03-I	X2CrNiMo17-12-2	316L *see* Note 8	S31603	Classed and certified *see* Note 7	Unwelded and welded *see* Note 3	Austenitic	-60
1.4410	4410-327-50-E	X2CrNiMoN25-7-4	A182 F53	S32750 *see* Note 8	Classed and certified *see* Note 7	Unwelded and welded *see* Note 4	Duplex	-20
1.4418	4410-431-77-E	X4CrNiMo16-5-1	SS 2387	-	Certified *see* Note 6	Unwelded *see* Notes 1, 2	Martensitic	*see* Note 5
1.4429	4429-316-53-I	X2CrNiMoN17-13-3 X2CrNiMoN17-12-3	316LN *see* Note 8	S31654 S31653	Classed and certified *see* Note 7	Unwelded *see* Note 3	Austenitic	-60
1.4434	4434-317-53-I	X2CrNiMoN18-12-4	317LN *see* Note 8	S31753	Classed and certified *see* Note 7	Unwelded *see* Note 3	Austenitic	-60
1.4435	4435-316-91-I	X2CrNiMo18-14-3	316L *see* Note 8	S31603	Classed and certified *see* Note 7	Unwelded and welded *see* Note 3	Austenitic	-60
1.4436	4436-316-91-I 4436-316-00-I	X5CrNiMo17-13-3 X3CrNiMo17-13-3 X3CrNiMo17-12-3	316	S31600	Certified *see* Note 6	Unwelded *see* Note 3	Austenitic	-60
1.4438	4438-317-03-I	X2CrNiMo18-15-4 X2CrNiMo19-14-4	TP317L 317L *see* Note 8	S31703 S31700	Classed and certified *see* Note 7	Unwelded and welded *see* Note 3	Austenitic	-60

1.4439	4439-317-26-E	X2CrNiMoN17-13-5	317LMN	S31726	Certified *see* Note 6	Unwelded and welded *see* Note 3	Austenitic	-60
1.4445	4445-317-00-U	X6CrNiMo19-13-4	317	S31700	Certified *see* Note 6	Unwelded *see* Note 3	Austenitic	-60
1.4460	4460-312-00-I	X3CrNiMoN27-5-2	329	S32900 S31200	Certified *see* Note 6	Unwelded and welded *see* Note 3	Duplex	-20
1.4462	4462-318-03-I	X2CrNiMoN22-5-3	2205	S32205 S31803 *see* Note 8	Classed and certified *see* Note 7	Unwelded and welded *see* Note 3	Duplex	-20
1.4501	4501-327-60-I	X2CrNiMoCuWn25-7-4	25-7-4	S32760	Certified *see* Note 6	Unwelded and welded *see* Note 4	Duplex	-20
1.4507	4507-325-20-I 4507-325-50-X	X2CrNiMoCuN25-6-3 X3CrNiMoCuN26-6-3-2	255	S32520 S32550	Certified *see* Note 6	Unwelded and welded *see* Note 4	Duplex	-20
1.4529	4529-089-26-I	X1NiCrMoCuN25-20-7	926	N08367 N08926	Certified *see* Note 6	Unwelded and welded *see* Note 4	Austenitic	-60
1.4539	4539-089-04-I	X1NiCrMoCu25-20-5	904L	N08904	Certified *see* Note 6	Unwelded and welded *see* Note 3	Austenitic	-60
1.4541	4541-321-00-I	X6CrNiTi18-10	321 *see* Note 8	S32100	Classed and certified *see* Note 7	Unwelded *see* Note 3	Austenitic	-60
1.4547	4547-312-54-I	X1CrNiMoCuN20-18-7	F44 254SMO	S31254	Certified *see* Note 6	Unwelded and welded *see* Note 4	Austenitic	-60
1.4550	4550-347-00-I	X6CrNiNb18-10	347 *see* Note 8	S34700	Classed and certified *see* Note 7	Unwelded *see* Note 3	Austenitic	-60
1.4561	-	X1CrNiMoTi18-13-2	-	-	Certified *see* Note 6	Unwelded *see* Note 3	Austenitic	-60
1.4565	4565-345-65-I	X2CrNiMnMoNbN25-18-5-4 X2CrNiMnMoN25-18-6-5	S34565	-	Certified *see* Note 6	Unwelded and welded *see* Note 4	Austenitic	-60
1.4571	4571-316-35-I	X6CrNiMoTi17-12-2	316Ti	S31635	Certified *see* Note 6	Unwelded and welded *see* Note 3	Austenitic	-60

Note *1*. Application must be sufficiently greased to ensure a high degree of protection from the environment and be subject to a strict maintenance regime.

Note *2*. Material only to be used for pin type applications.

Note *3*. Suitable for marine air atmosphere only.

Note *4*. Suitable for immersion in seawater (for temperatures below +35°C).

Note *5*. For Charpy V-notch test requirements *see Table 11.1.2 Charpy V-notch impact test temperature requirements for non-welded components with a minimum specified yield strength up to 960 MPa* and *Table 11.1.4 Charpy V-notch impact test energy requirements*.

Note 6. Application in classed lifting appliances design requires special consideration.

Note *7*. For requirements in classed applications *see Rules for the Manufacture, Testing and Certification of Materials*.

Note *8*. Material is specified in the *Rules for the Manufacture, Testing and Certification of Materials*.

1.2.9 Materials for use in hazardous environments are to be in accordance with a recognised National or International Standard. The Standard used is to be identified in the submitted specification.

1.2.10 Fatigue calculations shall be prepared according to a recognised National or International Standard for each application. The definition of fatigue non-critical and fatigue critical is as follows:

(a) Fatigue non-critical – Cyclic stresses are present, but the fatigue life is reasonably greater than the design fatigue life and it is anticipated that fatigue crack initiation and propagation are unlikely to occur.

(b) Fatigue critical – Cyclic stresses are present, and the estimated fatigue life meets the design requirements, but it is not significantly higher. It is anticipated that fatigue crack initiation and propagation are likely to occur.

1.2.11 For fatigue non-critical applications post-weld heat treatment is to be applied when the material thickness limits stated in *Table 11.1.6 Post-weld heat treatment thickness limits for fatigue non-critical applications (excludes castings and forgings)* are exceeded.

1.2.12 For fatigue critical applications post-weld heat treatment is to be applied for thicknesses exceeding 65 mm or those shown in *Table 11.1.6 Post-weld heat treatment thickness limits for fatigue non-critical applications (excludes castings and forgings)*, whichever is lower.

1.2.13 Post-weld heat treatment is further to be applied to the welding of steel castings where the thickness of the casting at the weld exceeds 30 mm.

1.2.14 Consideration is to be given to applying post-weld heat treatment for all thicknesses of complicated weld joints where there are high stress concentrations.

1.2.15 Where required, post-weld heat treatment is to be performed in accordance with the requirements specified in *Ch 13, 1.16 Post-weld heat treatment* and *Table 13.4.3 Post-weld soak temperatures and times* of the *Rules for the Manufacture, Testing and Certification of Materials*.

1.2.16 Special consideration may be given to omit the required post-weld heat treatment. Evaluation is to be based on engineering critical assessment (ECA) involving fracture mechanics testing, and proposals are to be submitted which include full details of the application, materials, welding procedures, inspection procedures, design temperature and stresses, and fatigue loads and cycles. Evidence will be required to demonstrate that the inspection techniques and procedures to be employed are able to detect flaws to the sizes and tolerances (of length, through-wall height and through-wall position) as determined from the fracture mechanics and/or fatigue calculations. Alternative procedures for the omission of post-weld heat treatment will be subject to special consideration.

Table 11.1.6 Post-weld heat treatment thickness limits for fatigue non-critical applications (excludes castings and forgings)

Minimum specified yield stress of the material (MPa), *see* Note 1	**Minimum design temperature**, *see* Note 2											
	−10°C			−20°C			−30°C			−40°C		
	Maximum actual stress, *see* Note 4											
	$\sigma_{0,67}$	$\sigma_{0,75}$	$\sigma_{0,85}$	$\sigma_{0,67}$	$\sigma_{0,75}$	$\sigma_{0,85}$	$\sigma_{0,67}$	$\sigma_{0,75}$	$\sigma_{0,85}$	$\sigma_{0,67}$	$\sigma_{0,75}$	$\sigma_{0,85}$
	Material thickness limit (mm), *see* Note 5											
Up to 390	220	160	110	200	150	100	170	130	80	130	100	70
420 to 500	180	125	100	150	125	100	120	100	75	110	80	65
550	120	100	70	100	80	65	80	60	50	65	50	35
620 to 690	90	60	50	70	50	40	50	40	25	30	25	20
890	45	35	25	30	20	15	*see* Note 3					
960	40	30	20	25	15	10						

Note *1*. For intermediate minimum specified yield stress values not shown in the Table, the next higher minimum specified yield stress band should be selected to determine the material thickness limit.

Note *2*. For intermediate design temperatures the next lowest design temperature shown in the Table should be selected to determine the material thickness limit. *See Ch 11, 1.2 General material requirements 1.2.4* for a definition of the minimum design temperature.

Note *3*. Post-weld heat treatment is required for all thicknesses.

Note *4*. The maximum actual stress, σ_{123}, is defined as the maximum principal stress occurring at the design detail under consideration. The actual stress ranges ($\sigma_{0,67}, \sigma_{0,75}, \sigma_{0,85}$) are defined as follows:

$\sigma_{0,67}$: $\sigma_{123} \leq 0{,}67\sigma_y$

$\sigma_{0,75}$: $0{,}67\sigma_y < \sigma_{123} \leq 0{,}75\sigma_y$

$\sigma_{0,85}$: $0{,}75\sigma_y < \sigma_{123} \leq 0{,}85\sigma_y$

where

σ_y = minimum specified yield strength of the parent material

Note *5*. For all applications where material thickness is greater than 65 mm, 100 per cent surface and volumetric non-destructive examination of welds is required.

1.2.17 The use of 'Z' grade steel is recommended where the structural steel is subjected to tension stresses in the through thickness direction (e.g. cruciform or t-shape joints). Where Z grade steel is specified, the requirements of *Ch 3, 8 Plates with specified through thickness properties* of the *Rules for the Manufacture, Testing and Certification of Materials* shall be met and, if necessary, supplementary guidance on selection of Z25 or Z35 may be obtained from a recognised National or International Standard acceptable to LR to ensure structural integrity of the proposed design.

1.3 General requirements for fabrication

1.3.1 Before fabrication commences an Inspection and Test Plan (ITP) shall be prepared by the designer/manufacturer. This ITP shall be further discussed and agreed between the designer/manufacturer of the lifting appliance (or its components) and the attending LR Surveyor. The ITP shall meet the requirements of this document.

1.3.2 The welding consumables are to be approved by LR. A list of currently approved welding consumables is published on the LR approval client portal: https://www.lr.org/en/lr-approvals.

1.3.3 The welding consumables are to be suitable for the type of joint and grade of material to be welded and are, in general, to match the parent material. For base material grades with minimum specified yield strength level of 890 N/mm² and 960 N/mm², the weld metal strength may be lower than the minimum specified for the base metal provided that the application has design approval for the undermatching weld metal. In such cases the weld metal strength is not to be less than that specified in the approved design.

1.3.4 The NDE requirements for classed lifting appliances are specified in *Ch 11, 2.1 General* and the requirements in this Section.

1.3.5 The NDE requirements for certified lifting appliances are specified in *Ch 11, 3.2 Fabrication* and the requirements in this Section.

1.3.6 The classification and acceptance criteria of weld imperfections shall be in accordance with ISO 5817 *Welding – Fusion welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections*.

1.3.7 The quality level of critical, primary and secondary welds and weld connections between critical, primary and secondary structural components shall be in compliance with *Table 11.3.1 Weld quality levels*.

Table 11.3.1 Weld quality levels

Welds and weld connections between components *see* Note 2	Quality level *see* Note 1
Critical welds or welds connected to critical structural components	B
Primary welds or welds connected to primary structural components	B
Secondary welds or welds connected to secondary structural components	D or higher
Note 1. The quality levels are defined in ISO 5817. **Note** 2. The definition of critical, primary and secondary welds is given in *Table 12.3.1 Minimum requirements for NDE*. The definition of critical, primary and secondary structural components is given in *Ch 11, 1.2 General material requirements 1.2.2*.	

1.3.8 Concerning welds subject to fatigue, reference is made to Annex C of ISO 5817 *Welding – Fusion welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections*.

1.3.9 For the welding procedure and welder qualification the quality level B as defined in ISO 5817 is to be applied.

1.3.10 The designer/manufacturer shall have a system of dimensional checks in place to ensure that the components and the system as a whole will be built in accordance with the approved drawings. The system shall verify the dimensional compliance with the approved drawings after welding operations and/or machining to the satisfaction of the surveyor.

1.3.11 A suitable corrosion protection system is to be selected and applied by the designer/manufacturer, depending on the expected corrosivity of the environment. If a protective paint system has been selected it shall comply with the requirements of the applicable parts of ISO 12944 *Paints and varnishes – Corrosion protection of steel structures by protective paint systems*. If there is no corrosivity category agreed between the Owner/Operator and the designer/manufacturer, the corrosivity category 'CX' as defined in ISO 12944 *Paints and varnishes – Corrosion protection of steel structures by protective paint systems* shall be selected. All items and areas are to be sufficiently protected against corrosion for the agreed protection duration of the system. If there is no protection duration agreed between the Owner/Operator and the designer/manufacturer, the durability range 'H' (as a minimum) as defined in ISO 12944 *Paints and varnishes – Corrosion protection of steel structures by protective paint systems* shall be selected. If the system is to be operated beyond the agreed protection duration or the duration of the durability range of ISO 12944 *Paints and varnishes – Corrosion protection of steel structures by protective paint systems*, additional maintenance inspections are to be carried out and appropriate defect criteria are to be defined in the maintenance section of the instruction for use.

Existing Section 2 has been deleted in its entirety and replaced with the below:

■ *Section 2*
Fabrication of classed lifting appliances

2.1 General

2.1.1 The fabrication and inspection of lifting appliances subject to classification are to comply with the *Rules for the Manufacture, Testing and Certification of Materials* and the appropriate Sections of this Code.

2.1.2 The requirements in *Ch 11, 1.1 Scope*, *Ch 11, 1.2 General material requirements* and *Ch 11, 1.3 General fabrication requirements* apply to classed lifting appliances.

2.1.3 Non-Destructive Examination is to be to the satisfaction of the surveyor and in accordance with the requirements of *Ch 1, 5 Non-destructive examination* in the *Rules for the Manufacture, Testing and Certification of Materials* and the minimum requirements given in *Ch 12, 3.2 Initial Survey of new installations 3.2.4*.

■ *Section 3*
Fabrication of certified lifting appliances

3.1 General

3.1.1 The fabrication and inspection of lifting appliances subject to certification is to comply with the requirements in this Section and the appropriate Sections of this Code.

3.1.2 The requirements in *Ch 11, 1.1 Scope*, *Ch 11, 1.2 General material requirements* and *Ch 11, 1.3 General fabrication requirements* apply to certified lifting appliances.

3.1.3 The requirements of the *Rules for the Manufacture, Testing and Certification of Materials*, or an agreed National or International Standard, are to be followed for the applicable fabrication and welding requirements not covered in this Section.

3.2 Fabrication

3.2.1 All standards related to welding procedures, qualification of welders, Non-Destructive Examination procedures, Non-Destructive Examination personnel qualifications and Non-Destructive Examination acceptance criteria are to be agreed with the surveyor prior to the commencement of work.

3.2.2 Welding procedures are to be in accordance with the *Rules for the Manufacture, Testing and Certification of Materials*, or an agreed National or International Standard. All welding procedures are to be qualified by testing and approved by the Surveyor.

3.2.3 All welders are to be qualified to the satisfaction of the Surveyor in accordance with the *Rules for the Manufacture, Testing and Certification of Materials* or other equivalent National or International Standards.

3.2.4 Following welding, visual inspection is to be carried out by qualified inspectors to ensure that the welds are in accordance with the approved plan and comply with agreed acceptance criteria. Surveyors will conduct visual examination spot checks to confirm the overall quality of the welds against the approved plan and agreed acceptance criteria.

3.2.5 Non-Destructive Examination is to be carried out by qualified Operators using procedures approved by Level 3 NDE personnel and accepted by the surveyor and according to the minimum requirements given in *Ch 12, 3.2 Initial Survey of new installations 3.2.4* to the Surveyor's satisfaction.

3.2.6 In addition to visual inspection, welds are to be non-destructively examined to verify their soundness. All Non-Destructive Examinations (NDE) are to be carried out to a written procedure that is representative of the item under inspection and they are to be based upon a National or International Standard. Personnel carrying out NDE or interpreting the results of NDE are to be qualified to the appropriate level of a nationally recognised scheme such as ISO 9712 *Non-destructive testing – Qualification and certification of NDT personnel*, ACCP (ASNT Central Certification Program (American Society for Nondestructive Testing (ASNT))) or an employer-based scheme such as SNT-TC-1A *Personnel Qualification and Certification in Nondestructive Testing*. Where employer-based schemes are applied, personnel qualification to these schemes may be accepted if the written practice is acceptable to LR. Level 1 personnel are not permitted to interpret results to Codes or Standards.

3.3 Re-testing of materials

3.3.1 Check tests may be required at the discretion of the Surveyor unless the material is sourced from an LR approved manufacturer, *see Ch 1, 1.6 Materials and fabrication 1.6.6*.

3.3.2 In general, the manufacturer's chemical analysis will be accepted but may be subject to occasional independent checks if required by the Surveyor.

3.3.3 When mechanical check tests are required, the specified tests are to be carried out by competent personnel using calibrated machines which are maintained in a satisfactory and accurate condition.

3.4 Rectification of defects

3.4.1 In all cases, the removal of defects, and repair by welding where appropriate, is to be carried out to the satisfaction of the Surveyor.

3.4.2 Surface imperfections may be removed by mechanical means as agreed with the Surveyor. After such treatment, the dimensions are to comply with an agreed National or International Standard and the area is to be confirmed to be free from defects. The work is to be completed to the satisfaction of the Surveyor.

3.4.3 For steel castings, flame scarfing or arc-air gouging may be used, provided that preheating is used where necessary and the surfaces of the resulting depression are subsequently ground smooth. The complete removal of all defects is to be confirmed by suitable Non-Destructive Examinations and the area is to be suitably prepared for welding.

3.4.4 Repair by welding is not to be carried out without the agreement of the Surveyor. Agreement of the Surveyor is to be obtained before the work is commenced.

3.4.5 The complete removal of all defects is to be proved by suitable non-destructive examinations and the area is to be suitably prepared for welding.

3.4.6 Welding is to be carried out using a qualified and approved procedure which is to include the selection of suitable welding consumables. Preheating and post-weld heat treatment may be necessary due to the particular chemical composition or dimensions of the weld repairs. The repairs are to be carried out by qualified welders under adequate supervision.

■ *Section 4*
Material documentation for certified and classed lifting appliances

4.1 General

4.1.1 The designer/manufacturer of the lifting appliance shall have a system in place which enables all materials to be traced from purchasing to receipt at the manufacturer's works and integrated into the construction of the lifting appliance. The Surveyors are to be given access for tracing the material when required.

4.1.2 Any deviation from the documentation requirements provided in the following shall be agreed with LR prior to any material being ordered for the actual project.

4.2 Material documentation for classed applications

4.2.1 The required documentation for the materials used in classed lifting appliances is specified in *Table 13.3.1 Minimum requirements for the classification of lifting appliances*. *See also Ch 1, 1.6 Materials and fabrication*.

4.3 Material documentation for certified applications

4.3.1 The required documentation for the materials used in certified lifting appliances is specified in *Table 13.2.1 Minimum requirements for the certification of lifting appliances*. *See also Ch 1, 1.6 Materials and fabrication*.

Chapter 12
Testing, Marking and Surveys

■ *Section 1*
Testing

1.7 ~~Launch and recovery systems for diving operations~~Manned submersible handling systems

1.7.1 For the purpose of these requirements, the term 'manned submersible handling systems' includes the handling of manned diving systems.

~~1.7.1~~1.7.2 Upon completion of preliminary tests necessary to ensure correct assembly and freedom of operation, each lifting appliance used for raising, lowering or transferring manned submersibles ~~or other manned diving systems~~ is to be subjected to the following tests:

(a) A 'static' load test equivalent to 1,5~~ x~~ SWL. In the case of cranes or A frames, this load is to be lifted at the maximum and minimum radii or inboard/outboard positions and at an intermediate position.

(b) A 'dynamic' load test equivalent to 1,1~~ x~~ SWL. This test is to demonstrate that the hoist brake system is capable of stopping the load whilst being lowered at maximum speed to simulate a power failure.

(c) An 'operational' load test equivalent to 1,25~~ x~~ SWL. This test is to be carried out over the full range of operation of the lifting appliance.

~~1.7.2~~1.7.3 Where the ~~diving system~~ manned submersible handling system is approved with hoisting factor of more than 1,7, the test loads indicated in *Ch 12, 1.7 ~~Launch and recovery systems for diving operations~~ Manned submersible handling systems ~~1.7.1~~ 1.7.2* are to be increased by the ratio of ~~$F_h/1{,}7$~~ $F_{h.swh}/1{,}7$, where ~~F_h~~ $F_{h.swh}$ is derived from *Ch 4, 4 Submersible handling systems*.

~~1.7.3~~1.7.4 If testing to values in excess of those defined in *Ch 12, 1.7 ~~Launch and recovery systems for diving operations~~Manned submersible handling systems ~~1.7.1~~ 1.7.2* and *Ch 12, 1.7 ~~Launch and recovery systems for diving operations~~Manned submersible handling systems ~~1.7.2~~ 1.7.3* is envisaged, a review of the manned submersible handling ~~launch and recovery~~ system should be undertaken to ensure that overstressing does not occur.

~~1.7.4~~1.7.5 For the purpose of these requirements, the safe working load of the appliance is to be taken as the greater of:

(a) The maximum in-air weight of the ~~diving system~~ manned submersible, lifting frame and rope when it is at water surface; or

(b) The total submerged weight of the ~~diving system~~ manned submersible, lifting frame and rope when it is at its maximum operating depth.

~~1.7.5~~1.7.6 Following the overload test, the ~~lifting appliance~~ manned submersible handling system is to be operated with its SWL over the complete operating cycle to demonstrate the effective operation of the system, the accuracy of overload and safe load indicators and the effectiveness of limit switches, etc.

~~1.7.6~~1.7.7 After testing, the ~~lifting appliance~~ manned submersible handling system is to be thoroughly examined for deformations and other defects.

~~1.7.7~~1.7.8 Further tests in accordance with LR's *Rules and Regulations for the Construction and Classification of Submersibles and Diving Systems* ~~(hereinafter referred to as the Rules for Submersibles)~~ may be required and reference is made to that publication. Where compliance with National Authority Regulations is required, specific reference should be made to the Regulations in case any additional or more onerous test requirements are appropriate.

■ *Section 3*
Survey requirements

3.2 Initial Survey of new installations

3.2.3 ~~All welding is to be carried out in accordance with an approved WPS by suitably qualified welders and is to be to the satisfaction of the Surveyor, *see Ch 11, 2 Fabrication of lifting appliances*.~~ All welding is to be carried out in accordance with an approved WPS by suitably qualified welders and is to be to the satisfaction of the Surveyor, *see Ch 11, 2 Fabrication of classed lifting appliances* and *Ch 11, 3 Fabrication of certified lifting appliances*.

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